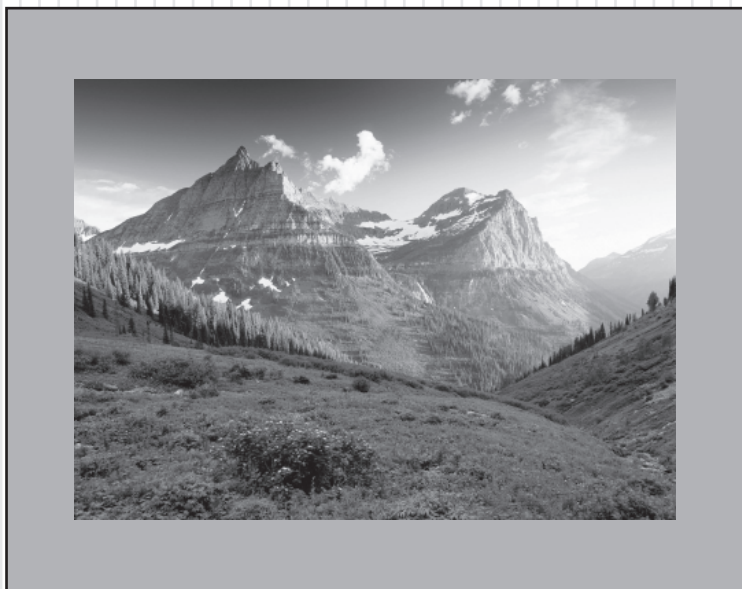# Montana Comprehensive Assessment System *(MontCAS, Phase 2)*

Criterion-Referenced Test (CRT)

COMMON CONSTRUCTED-RESPONSE ITEM RELEASE
MATHEMATICS, GRADE 10

2006

OPI

OFFICE OF PUBLIC INSTRUCTION

You may use a calculator during this session.

25. Look at the figure below.

a. What is the measure of ∠1? Justify your answer geometrically.

b. What is the measure of ∠3? Justify your answer geometrically.

c. Justify geometrically that quadrilateral *ABCD* is a parallelogram.

Scoring Guide

Score	Description
4	5 points
3	3 – 4½ points OR 2½ points provided points earned in all three parts
2	1½ – 2½ points
1	½ – 1 point OR Student shows minimal understanding for recognizing 1 geometric property (i.e., angle 5 is supplemental to the given 120º angle).
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

Scoring Notes

Part a: 1 point   for correct answer, **60°**, and correct justification
         OR
     ½ point   for correct answer

Part b: 2 points   for correct answer, **60°**, and correct justification
         OR
     1 point   for correct answer with apparently correct reasoning, expressed vaguely, with significant error(s) or incorrect terminology
         or
         for finding angle 4 (40º) with correct justification

Part c: 2 point   for correct justification
         OR
     1 point   for correct answer with apparently correct reasoning, expressed vaguely, with significant error(s) or incorrect terminology

Sample Response

Part a: complementary to 30° angle DAF
     OR
     90 – 30 = 60

Part b: 120 = 80 + (angle 4) Exterior angle theorem to get angle 4 (40°), then subtraction from 100° to get 60º
     OR
     Angle 5 is supplementary to 120° so it equals 180 – 120 = 60°. Then Triangle Sum theorem gives angle 4 (180 – 80 – 60 = 40°) and subtraction from 100° to get 60º.

Part c: find angle 2 (120°) by sum of interior angles of a quadrilateral and then conclude parallelogram because two pairs of opposite angles are congruent.
     OR
     since angles 1 and ADC are supplementary, sides $\overline{AB}$ and $\overline{CD}$ are parallel and since angles 3 and ADC are supplementary, sides $\overline{BC}$ and $\overline{AD}$ are parallel.

Score Point 4

Sample 1

a) ∡1 = 60° because since ∡A = 90° and 30° is complementary to
∡1, 90-30 = 60°

A ←∡1 A=90
        -30
        60°

b) ∡3 = 60° because:
  • Since ∡5 + 120° are supplementary, ∡5 = 60°
  • In △DEC, we know 2 of the ∡'s are 60° + 80°. Therefore,
    ∡4 must be 40° so that all the ∡'s add up to 180°
  • Since ∡4 is adjacent ∡3, and they = 100, ∡3 must
    be 60°

c) ABCD is a parallelogram
because its opposite angles
are equal.
  • We know that ∡1 = 60°,
    ∡D = 120, and ∡3 = 60°.
    So, ∡B must equal 120°
    for it to add up to 360°
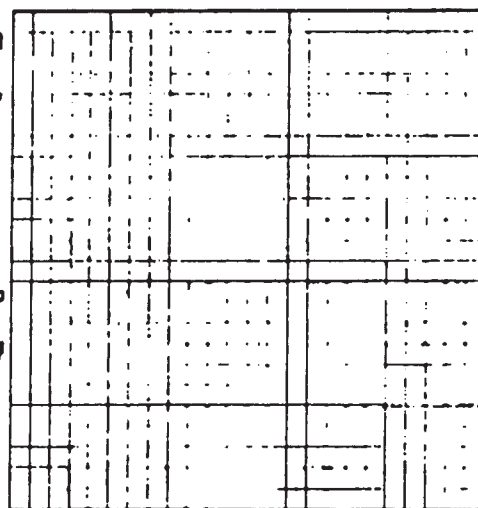
a. 60° ∠BAF=90° 90-30=60°
   ∠EAF=30°

b. 60° ∠3+∠4=100 ∠E=80
        180-120=∠5 ∠5=60
        60+80=140 160-140=20
        ∠4=40 100-40=60
        60=∠3

c. ∠BCF=60° } opp. angles ≅
   ∠1=60°
   ∠CDA=120 } opp ∠'s ≅
   ∠2=120

a. $90° - 30° = \boxed{60°}$

b. $3 + 4 = 100°$ $\angle 3 = \boxed{60°}$

c. $120° + 120° + 60° + 60° = 360°$

the opposite angles are the same

a° 90
  − 30
  60°

b 180
  −120°
  ∠5=60° + 80° = 140°   180°
                              ∠4=140°

  100 − ∠4=140°
  − 40°
  ∠3= 60°

c

Score Point 2

Sample 1

a. A - RIGHT ANGLE (RIGHT ANGLE = 90°)
    $n + 30 = 90$
    $\angle 1 = 60°$

b. $\angle D = 180°$
    $\angle 4 + \angle 5 + \angle E = 180°$
    $120° + n = 180°$
    $\angle 5 = 60°$
    $80° + 60° + n = 180°$
    $\angle 4 = 40°$
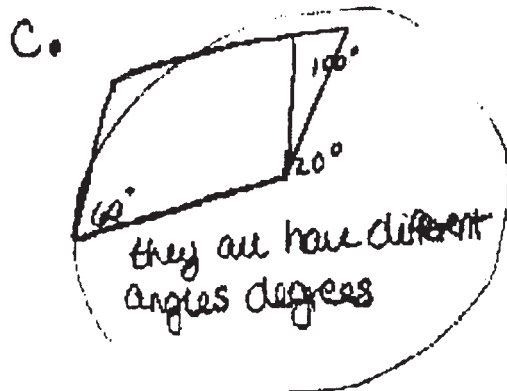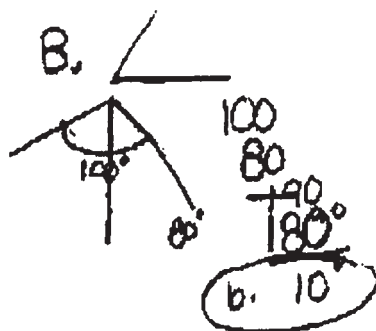
A.) measure of angle 1 = 30°, because there is a 90° angle, so it has to be complimentary

B.) measure of angle 3 is 60° because ∠5 is an linear pare w/ 120, then you have the two angles of the triangle. that ment ∠4 was 40,

So $\boxed{∠3 = 60°}$

C.) it has 4 angles that go to a slant.

a.   [angle diagram with 30°]

$$\begin{array}{r} 90 \\ -30 \\ \hline \end{array}$$

a. 60°

B.   [angle diagram with 140° and 80°]

$$\begin{array}{r} 100 \\ 80 \\ +90 \\ \hline 180° \end{array}$$

b. 10

C.   [parallelogram diagram with 100°, 120°, 60°]

they all have different
angles degrees

0.60

6.60

G

a. 75°
b. also 75°

$120° + 30° = \dfrac{150°}{2} = 75°$

c. quadrilateral ABCD is a parallelogram because its two vertical sides are parallel and its two horizontal sides are parallel

a. ∠1 = 90°

b. ∠3 = 30°   ∠D = 120   360
            ∠B = 120   −330
            ∠A = 90   ‾‾‾‾‾‾
            ‾‾‾‾‾‾   30 = ∠3
            330

c. Yes It is because 2 side will Never touch each other.
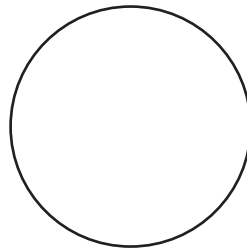
73. Many movies use computer-generated animation. To convey the sense of movement on the screen, an image will grow or shrink over time. The figures below show the initial image of a circular window, together with its radius and area, as well as the growth of the initial image over various numbers of seconds.
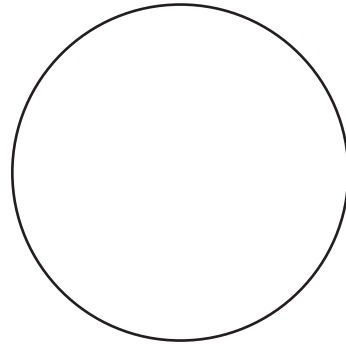

Time: 0 sec.
Radius: 1 cm
Area: π cm^2
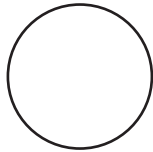
Time: 1 sec.
Radius: 3 cm
Area: 9π cm^2

Time: 2 sec.
Radius: 5 cm
Area: 25π cm^2

Time: 3 sec.
Radius: 7 cm
Area: 49π cm^2

a. According to this pattern, what would be the radius and area at 4 seconds?

b. Write an equation showing the relationship between the radius, r, of the circle and the number of seconds, t.

c. Use the equation you wrote in part b to find how many centimeters long the radius of the circle will be after 20 seconds. Show or explain how you found your answer.

d. Use the equation you wrote in part b to find the number of seconds it will take for the image to have a radius of 65 centimeters. Show or explain how you found your answer.

e. Explain why you would describe the relationship between time and area as linear or nonlinear.

Scoring Guide

Score	Description
4	5 points
3	3½ – 4½ points
2	2 – 3 points
1	½ – 1½ points OR Student shows minimal understanding of the problem.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Scoring Notes

Part a: 1 point   for both correct answers, **9 cm and 81π sq. cm.**
                        OR
       ½ point   for one of the two correct answers
                        or
                        for the wrong radius and correct square of that radius for the area

Part b: 1 point   for correct equation, $r = 2t + 1$

Part c: 1 point   for correct answer based on student's equation in part b with correct work, **41** if part b is correct
                        OR
       ½ point   for correct answer based on student's equation in part b, without work
                        or
                        for correct substitution in student's equation in part b, with incorrect or no answer

Part d: 1 point   for correct answer based on student's equation in Part b with correct work, **32 (seconds)** if part b is correct
                        OR
       ½ point   for correct answer based on student's equation in part b, without work
                        or
                        for correct substitution in student's equation in part b, with incorrect or no answer

Part e: 1 point   for correct answer, **nonlinear**, with explanation

Notes

- A student who gives a correct answer to part c or d but shows work not involving an equation and does not earn points for parts a, b, or e can be given a minimal 1 rating.
- The student should not be awarded any points for part e for giving an answer of non-linear with no explanation.
- Deduct 1 point if incorrect units are used in any part – do not penalize for missing units.

Sample Response

Part a: Radius is next odd number – 9 cm.

Area is πr^2 and r = 9 so area $= \pi 9^2 = 81\pi$ sq. cm.

Part b: $r = 2t + 1$

Part c: $r = 2 \times 20 + 1 = 41$

Part d: $65 = 2t + 1$
$2t = 64$
$t = 32$

Part e: Nonlinear because (any of the following is correct):

- Area is squared while time is not; therefore it cannot be a linear relationship
- Both do not increase at the same amount
- Area does not increase at a constant amount while time does or anything equivalent
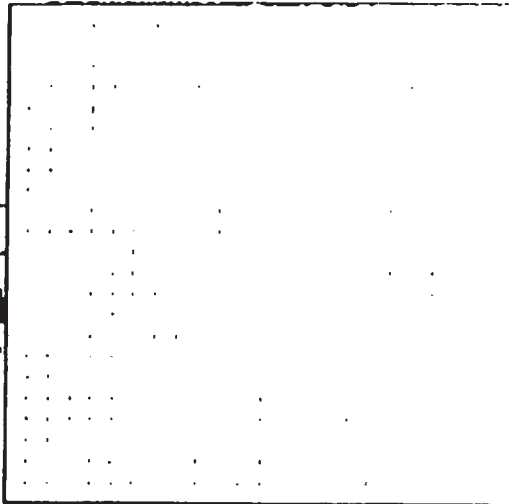
a) radius: 9cm Area: 81 π cm²

b) Every second the radius grows by 2cm, so r = (t×2)+1.

c) (20×2)+1 = 40+1 = 41cm. In the equation (t×2)+1 = r, then it follows that t=20, 20×2=40, and 40+1=41.

d) 65-1 = 64÷ 2= 32 sec. The reverse of the equation in part b is (r-1)÷2 = t. It follows that
r=65, 65-1=64, and
64÷2=32 sec.

e) The relationship between time and area is nonlinear because, as time goes by, depending on the object and other outside factors, the area of the given object either increases or decreases, but it's not always the same amount of increase or decrease. If the relationship were linear, the increase or decrease would always be the same regardless of the object specified.

a) Radius: 9
   Area: 81 π cm²

b) r = 2t + 1

c) r = 2(20) + 1
   r = 40 + 1
   r = 41 cm

d) 65 = 2t + 1
   64 = 2t
   32 = t

e) the relationship is
   nonlinear because the
   area doesn't increase at
   a constant rate.

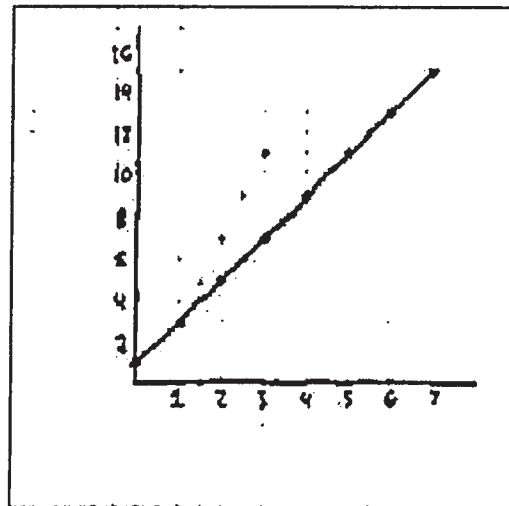a. Radius: 9 cm
   Area: $81 \pi \, cm^2$

b. $r = 2t + 1$

c. 41 cm $2 \cdot 20 = 40 + 1 = 41$

d. 32 sec $65 - 1 = 64 \div 2 = 32$

e. The relationship would
   be linear be linear
   because it keeps going
   in a straight line

a. 9 cm

b. $\begin{array}{cccc} 0 & 1 & 2 & 3 \\ 1 & 3 & 5 & 7 \end{array}$ $r = (2t) + 1$
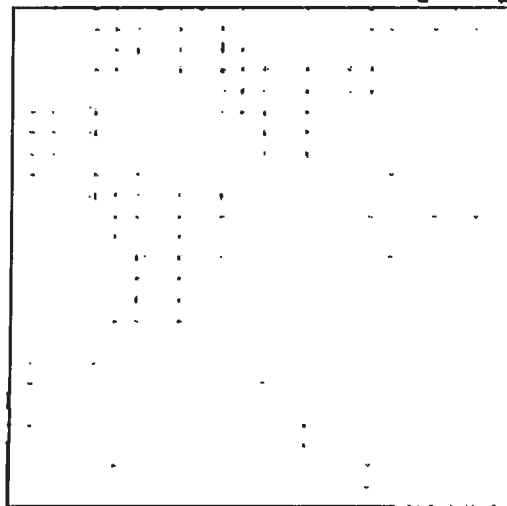
c. $r = 2(20) + 1$

$r = 40 + 1$

$\boxed{r = 41 \; cm}$

d. $\dfrac{65}{-1} = 2t + \dfrac{1}{-1}$

$\dfrac{64}{2} = \dfrac{2t}{2}$

$32 = t$

$\boxed{t = 32 \; seconds}$

e. It would be linear because it has a constant change so a line would fit the solution set on a graph the best

A) $16\pi \, cm^2$

B) $r = 2t + 1$

C) $r = (20) + 1$
   $r = 41$

   $\begin{array}{r} 41 \\ \times 41 \\ \hline 41 \\ 1640 \\ \hline 1681 \end{array}$ Area = $41^2 \pi \, cm^2$
   Area = $1681 \pi \, cm^2$

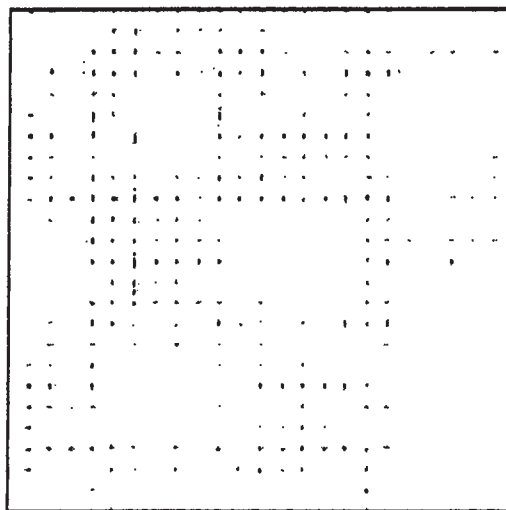D) $\begin{array}{r} 65 = 2t + 1 \\ -1 \quad\quad -1 \end{array}$

   $\dfrac{64}{2} = \dfrac{2t}{2}$

   $\begin{array}{r} 32 \\ 2\overline{)64} \\ \hline \end{array}$ $\boxed{t = 32}$

E) nolinvar, because they are never
   equal

a. 9cm

b. R = (↑×2)+1

c. 41 cm

d. 32 seconds

e. It would be linear because they have a direct conection with each other

A.) Radius: 9 cm   Area: 6/ πcm²

B). wey 5 another pattern of cm.

C). After 20 seconds   Radius = 4/cm

D). 32 seconds

E.) non linear because the line would never match up

A. 9 cm

B. $T = r + 2$

C. $20 = r + 2$

   $r = 41$ cm after 20 seconds

D. | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
   | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 |

   32 seconds

E. nonlinear because the radias and time are never the same apart

A) 14 cm

B) R+T = Area

C) 40 feet

D) 100 cm

e) linear because they are parallel

a.

Time : 4 sec.
Radius: 4 cm
Area: 18πcm^2

b. $Rt = a$

c.

d.

f. Time is based on area.